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The Journal of HEREDITY

A monthly publication devoted to Plant Breeding Animal Breeding and Eugenics

PREHISTORIC POTATO VASES FROM PERU

(See Page 175)

Rumplessness in the Domestic Fowl
Landauer & Dunn

Causes of Mongolism
M. G. Schlapp

A Gigantic Strain of Maize
W. H. Eyster

Idiots as Reversions
A Review

MAY, 1925 VOL. 16 No. 5

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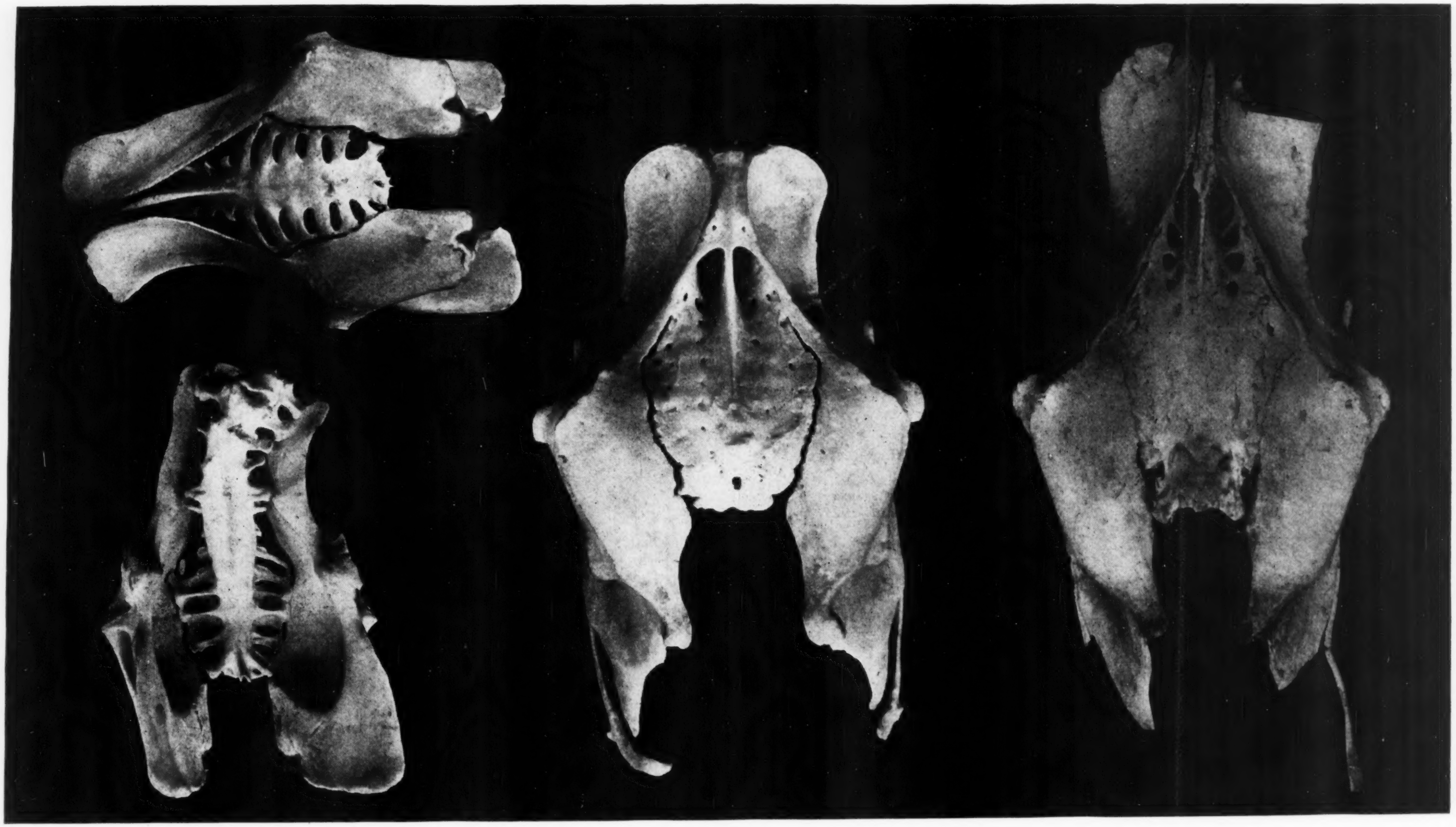

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PELVIC BONES OF HEREDITARY AND ACCIDENTAL RUMPLESS FOWLS

Figures 1-3

The two types of rumplessness are produced by entirely different causes, and yet morphologically no constant difference between them is to be found. Figure 1 shows both dorsal and ventral views of the pelvis of an hereditary rumpless fowl; Figure 2, accidental rumplessness; Figure 3, hereditary rumplessness, both ventral views.

TWO TYPES OF RUMPLESSNESS IN DOMESTIC FOWLS

A Morphological Comparison

WALTER LANDAUER AND L. C. DUNN
*Storrs Agricultural Experiment Station**

THE occurrence of two types of rumplessness in the fowl has been reported recently in this Journal.[1] Although similar in general appearance, these two types are apparently due to different sets of causes. One type (hereditary rumplessness) is inherited as a dominant trait; the other (accidental rumplessness) appears not to be inherited. Because of the general resemblance between these two types, we have made a detailed morphological comparison between the bones and musculature of the two types of rumplessness and of the normal fowl.

Until recently very little has been known about the anatomy of the rumpless fowl. The first genetic studies of this character by Davenport[2], [3] were made without exact knowledge of the relations of the anatomical parts. Until 1911 only scattered observations on the general appearance of the rumpless fowl had appeared in the literature. The paper of Libon[7] added only a few morphological observations on his rather scanty material. In 1913 du Toit[8] published the first exact and detailed observations on the morphology of rumplessness. Our results are in essential agreement with his.

The material which we have examined consists of the bones of eight hereditary rumpless fowls, and of three cases of accidental rumplessness. Fresh specimens of two hereditary and two accidental rumpless fowls were dissected.

1. General Appearance

Because of the absence of the tail, the rumpless fowl usually assumes a more erect posture than the normal fowl. This is most clearly seen in large fowls or cocks (Figure 8, p. 128). Such a change in the inclination of the body involves a readjustment in the equilibrium of the animal, and this is accomplished by changes in the angles between the bones of the leg, such that the metatarso-tibial angle becomes more obtuse, while the tibio-femoral angle becomes somewhat more acute. We have not been able to detect any significant changes in the skeleton or the musculature following these changed relations.

The posterior end of the body of the rumpless fowl is rounded (Figure 8, p. 128). In the region occupied normally by the tail vertebrae is an elongated cavity bounded laterally by the ischia and proximally by the posterior border of the ilia. The skin of the cavity is distally continuous with the body wall. No vertebrae of the tail are apparent externally.

In general, the feathers of the tail are entirely missing; but in several cases up to three tail feathers have been present. On the other hand, the feathers of the saddle in the male are usually somewhat longer than in the normal fowl and frequently overhang the cloaca.

2. The Oil Gland

Since Darwin first noted the absence of the oil gland in the rumpless fowl, that fact has been verified by several authors (Davenport, Libon, etc.). Among all of the rumpless fowls of both types examined by us, the oil gland also has been entirely missing.

*Contributions in Genetics 34.

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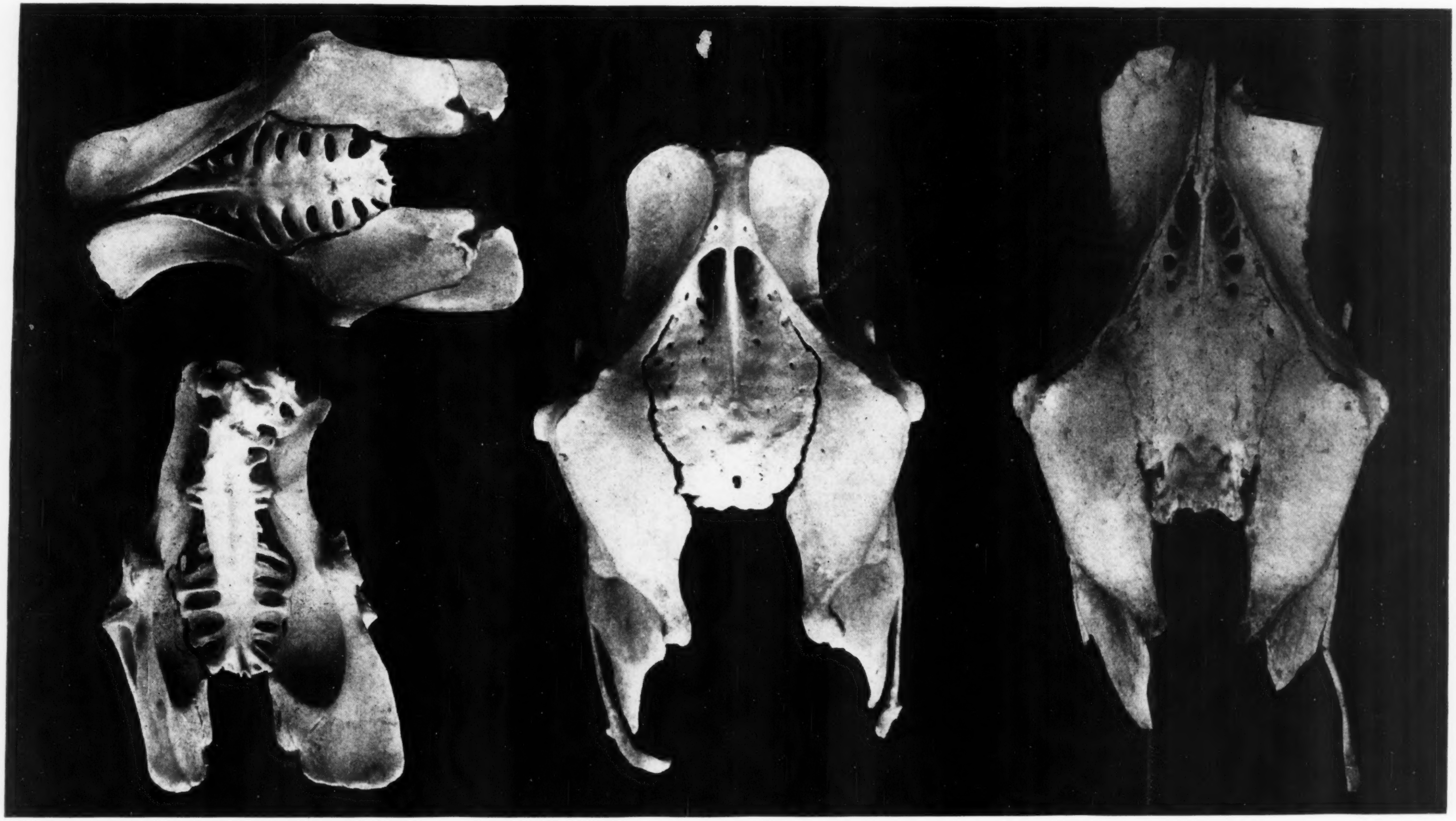

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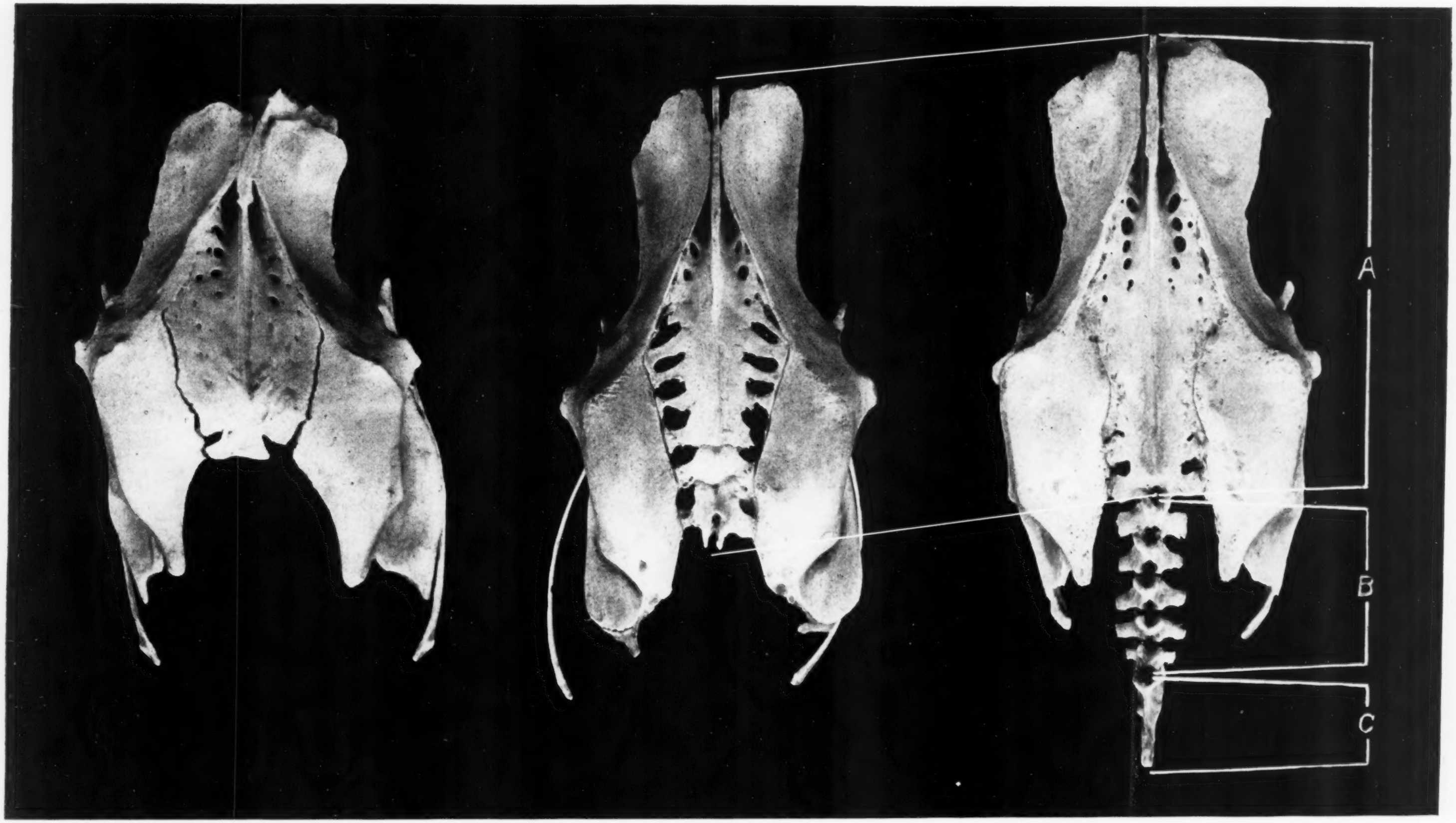

4 5 6

PELVIC BONES OF A NORMAL FOWL COMPARED WITH TWO TYPES OF RUMPLESS FOWLS

Figures 4-6

All are dorsal views. Figure 6 shows the normal bones; Figure 5, those of an hereditary, and Figure 4 those of an accidental rumpless fowl. In Figure 6 are shown the three divisions of the synsacro-caudal vertebrae: *A*—synsacral; *B*—free caudal vertebrae; and *C*, pygostyl. In the cases illustrated in Figures 4 and 5 the divisions *B* and *C* are congenitally absent.

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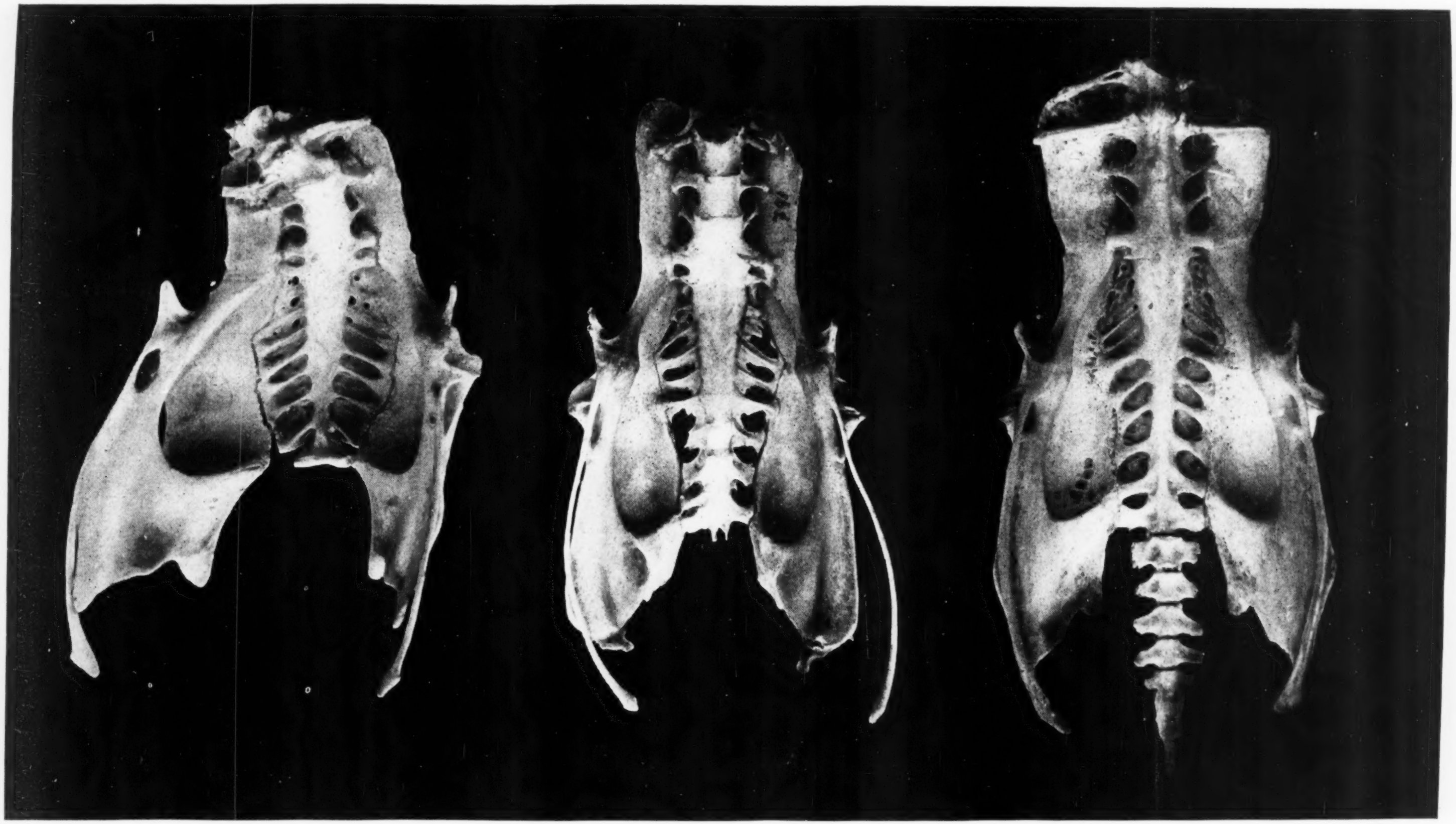


7 8 9

VENTRAL VIEWS OF PELVES SHOWN ABOVE

Figures 7-9

Figure 7, accidental rumplessness; Figure 8, hereditary rumplessness; Figure 9, normal.

Libon found accumulations of fat in the region where the oil gland is situated normally, and he supposed that this fat represented the remains of the oil gland. In our opinion, there is no reason to assume such a relation between the missing gland and the accumulation of fat. In both the normal and rumpless fowls these accumulations are so variable that it is impossible to establish any regular relation.

3. The Skeleton

The deficiency of parts of the skeleton of the tail is the primary factor in the production of rumplessness, and it is in this region, therefore, that we find the most extreme deviations from the normal condition. According to du Toit, the synsacrum (Figure 6A) of the normal fowl contains sixteen vertebrae,* while the tail contains five free caudal vertebrae (Figure 6B), and a pygostyl or terminal blade-like bone (Figure 6C) formed by the fusion of six vertebral anlage. In rumpless fowls of both heritable and accidental origin, the free caudal vertebrae and the pygostyl are missing. But it is significant that the last two vertebrae of the synsacrum (synsacro-caudal vertebrae) are also missing. The normal skeleton of the synsacrum and tail is composed of twenty-two vertebrae (the pygostyl counted as one), while in the rumpless fowl these parts consist of only fourteen vertebrae. This absence of vertebrae is the essential characteristic of the pelvis of the rumpless fowl. The anterior sections of the pelvis are entirely normal. The di- and especially the parapophyses of the vertebrae in the pelvis of the rumpless fowl are thinner and considerably smaller than in the normal pelvis. The apophyses of the last synsacro-caudal vertebra frequently terminate freely in the rumpless fowl, and usually the vertebra and its apophyses have fused into a homogeneous triangular plate which is curved downward (Figures 4, 7). In one case (Figure 11, ventral view) the four last vertebrae with their apophyses are fused one with another. Because of the large variability, further irregularities in the structure of the pelvis are difficult to judge and we find it impossible to say whether or not they are regular consequences of rumplessness. However, we have gained the impression from our material that in rumpless fowls the spine is more frequently curved than in normals. Figures 1, 4 and 7 give dorsal and ventral views of two extreme cases of such curvature. Further, assymetries of the both sides are very common, so that ischium and ilium of the one side seem to be considerably larger and to extend further backward (Figures 3, 4. 7). We say "seem to be" because measurements show that the assymetry is caused only in a small degree by enlargement of bones on the one side. Apparently the chief cause of the assymetry is a pressure exerted on the inner side of the curvature which displaces the bones of that side backward. The two clearest cases (Figures 2, 3) are in agreement with that interpretation. The end of the spine shows the greatest variability. In the simplest cases (Figures 5, 8) there is a median fission of the last vertebra with two flattened processes in distal direction between which the spinal cord passes. Figures 3, 4, 7 show the above-mentioned cases of fusion of the last vertebra and its processes to a uniform plate and finally we have in many cases a large variability of prominences and protuberances (Figures 10, 12, 13), the development of which is probably in-

*Divided as follows:
1. Synsacro-thoracic vertebrae with free ribs: 1.
2. Synsacro-thoraco-lumbar vertebrae, usually without free ribs, but with enlarged transprocesses or fission of the transprocesses in di- and par-apophyses: 4.
3. Synsacro-lumbar vertebrae without parapophyses: 4.
4. Synsacro-sacral vertebrae (primare Sakralwirbel oder Acetabularwirbel-Gegenbauer) with double transprocesses and rudimentary ribs: 2.
5. Synsacro-caudal vertebrae, the last section of the synsacrum: 5.

duced by mechanical impulses. These structures have no comparative anatomical meaning. Morphologically they serve as points of insertion for the fasciae of certain muscles. The canal of the spinal cord usually opens toward the back. The position of the opening also varies considerably. Sometimes the opening lies exactly terminal (Figures 1, 8), sometimes it is irregularly displaced dorsally (Figure 2), and only in one case is an opening entirely missing.

In the above discussion we have made no distinction between the accidental and hereditary types of rumplessness. The same anatomical observations which apply to one apply equally to the other.

4. The Musculature

The musculature of the pelvis of the rumpless fowl differs considerably from that of the normal fowl due to the radical changes in the skeleton. Du Toit says that nearly all muscles are present and only displaced in the rumpless fowl. We cannot verify that fully, for we find that not only may some of the muscles of the rumpless fowl gain new attachments, but some may even be entirely missing.

Those muscles whose location and attachments are altered are in the first place the two large muscles (the levator coccygis and the depressor coccygis) which regulate the vertical movements of the tail. In the rumpless fowl the remnants of these muscles overlie the posterior part of the body between the ilia and ischia, which in normal fowls contains the tail vertebrae. The levator coccygis* in the rumpless fowl has its origin on a limited area of the ilium, turns downward one centimeter before the outermost tip of the ilium (in the region of the noduliform thickenings on the last synsacral vertebrae) and as a small band follows the upper and interior border of the ischium into the post-pubis. The depressor coccygis in the opposite direction has its origin as normally "from the lower half of the posterior margin of the ischium and the anterior three-fourths of the post-pubis" (Kaupp)[4] and from there takes its course upwards to the noduliform thickenings, which serve its single fasciae for insertion. The muscle-bundles of both sides meet each other and fuse a short distance before their insertion. The levator and depressor coccygis of each side lie very close to each other following the interior border of the ischium.

The insertion of one other muscle, which however is not strictly a tail muscle, is changed. This is the caudilio femoralis which normally connects the hind limb with the tail and regulates the vertical movements of the rump while walking. In the rumpless fowl the distal insertion of this muscle is on the pelvis instead of on the tail. The muscles of the anus (transversoanalis, sphincter ani, contractor cloacalis, suspensor ani and dilatator ani) suffer small changes in the rumpless

*We are following the nomenclature of du Toit. Since his nomenclature is not in agreement with that of Kaupp, we give a comparison of the two terminologies:

Du Toit	Kaupp	Du Toit	Kaupp
Muscles of the tail:		Muscles of the cloaca:	
Levator coccygis (upper part)	Levator coccygis	Transverso-analis	Transversus Peroani
Levator coccygis (lower part)	Levator caudae	Sphincter ani	Not cited in Kaupp's work.
Interspinales	Interspinales	Contractor cloacalis	
Depressor coccygis	Depressor coccygis	Suspensor ani	
Intertransversarii	Intertransversarii	Dilatator ani	
Ilio-coccygeus	Lateralis coccygis		
Pubi-coccygeus externus	Lateralis caudae		
Pubi-coccygeus internus	Depressor caudae		
Adductor (Contractor) rectricum	—		
—	Infracoccygeus		
Caud-ilio-femoralis	Femoro-caudal		

fowl corresponding to the general changes in relative position of parts. Otherwise they are entirely normal.

The most striking differences between the musculature of normal and rumpless fowls are naturally to be found in the region of the tail itself. Several of the tail muscles are entirely missing, viz: the musculi interspinales (divisions of the levator coccygis) which lie normally between the spinal processes and the musculi intransversarii (divisions of the depressor coccygis) which lie normally between the transprocesses of the vertebrae of the tail. In addition to these muscles, according to du Toit only the adductor (contractor) rectricum is regularly missing, while the other muscles are only displaced. We find, however, that the three other tail muscles (iliococcygeus, pubi-coccygeus externus and internus) may also be entirely absent in both types of rumpless fowls.

As in the skeleton, no constant differences could be established between the muscles of the hereditary (Figures 1, 3, 5, 8, 11, 12) and accidental (Figures 2, 4, 7, 10, 13) types of rumplessness. Both show a considerable degree of variability. It is very remarkable that so well pronounced an anatomical condition as rumplessness may be brought about in the same way by two sets of causes which the genetic evidence shows to be distinct.

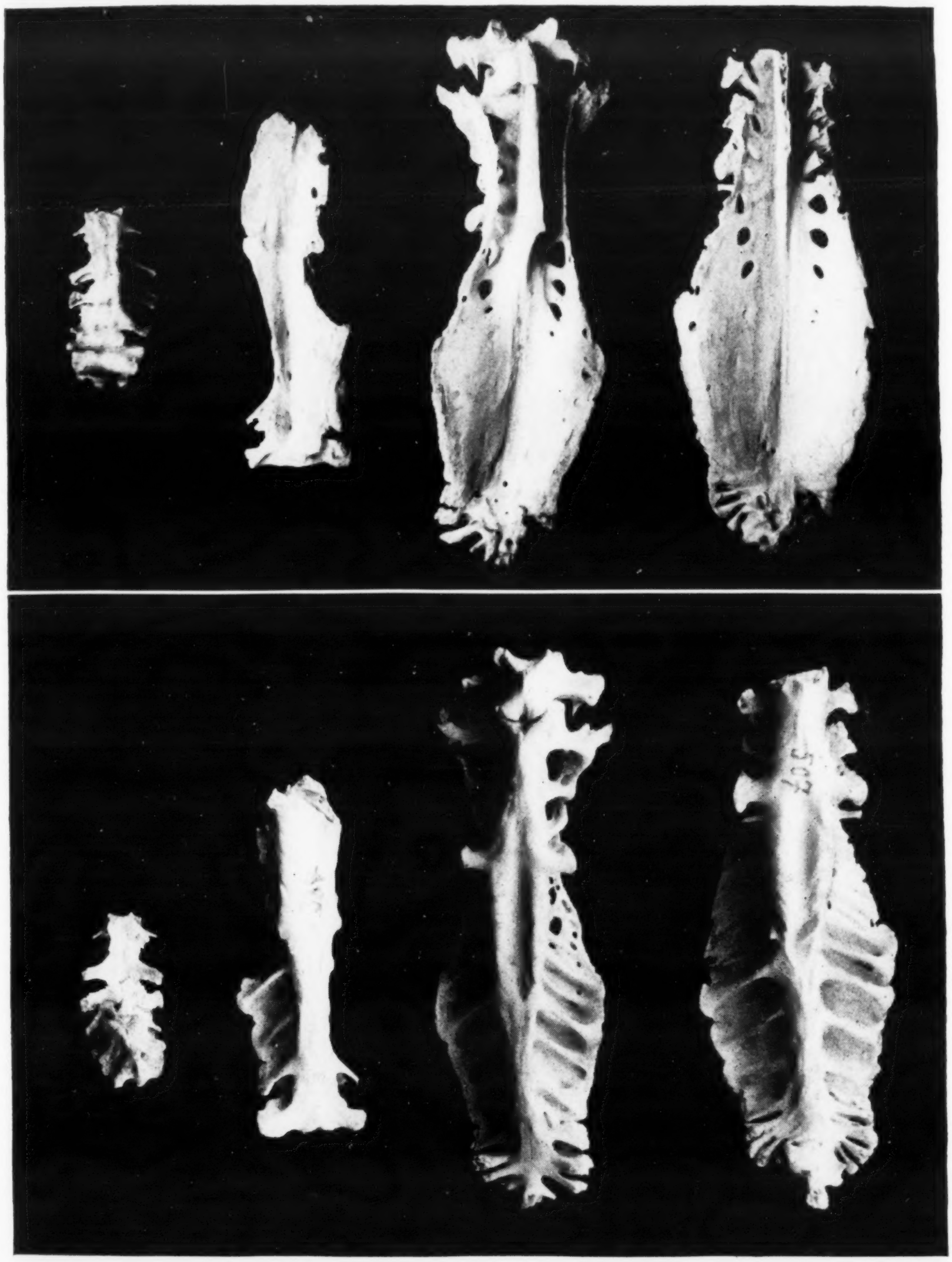
5. Nervous System and Blood Vessels

We have not made any new comparisons between the nerves and the blood vessels of the normal and the rumpless fowl. The exact investigations of du Toit have shown convincingly that, aside from the shortening of the elements conditioned by the skeletal deficiencies, no essential change can be seen.

The Origin of Hereditary Rumplessness

Considerable interest attaches to the developmental origin of rumplessness. This condition, whether of genetic or accidental origin, is clearly visible at the time of hatching and apparently does not change during the growth of the chicken. The question arises whether the absence of tail vertebrae is due to a reduction in the number of vertebral elements laid down in the earliest stages of embryogeny or whether it is due to a progressive resorption of anlage during embryonic development. From the few rumpless embryos which he examined, Libon concluded that all of the vertebrae have normal anlage and that even on the ninth day of incubation all free tail vertebrae and the pygostyl are present. But in one embryo which had been incubated for twelve days he found that these vertebrae were missing entirely. From this slight evidence Libon concluded that a reduction of the vertebrae takes place on the tenth or eleventh day, and that rumplessness is thus a result of resorption of vertebral anlage relatively late in development. Du Toit's investigations are much more exact and detailed and made on a larger volume of material. He examined all stages of the embryological development beginning with the third day, and he found that in the rumpless embryos the anlage of the vertebrae of the tail are absent from the beginning.

According to Lang,[5] the most probable explanation of Libon's results is that he obtained from heterozygous rumpless fowls both normal and rumpless embryos, and that his observations on early stages were made on normal embryos, while his single late embryo was a rumpless. This is probably true, for our data show that most rumpless fowls are heterozygous and produce both rumpless and normal embryos. Du Toit's account of the situation, on the other hand, is convincing and seems to remove any doubt that rumpless fowls begin their development with fewer vertebrae than the normal. These observations relate, of course, only to rumplessness of the hereditary type.



10 11 12 13

SYNSACRAL VERTEBRAE OF FOUR RUMPLESS FOWLS

Figures 10-13

Both ventral and dorsal views are shown. Figures 10 and 13 are the vertebrae of accidental rumpless fowls; Figures 11 and 12 are those of hereditary rumpless fowls. Figures 12 and 13 illustrate the occurrance of similar fusions and protuberances in both types of rumplessness.

No studies of the origin of accidental rumplessness have been made, and because of the rare and unpredictable occurrence of this variation its developmental history will probably remain unknown.

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The Renascence of the Cro-Magnons

DIE HELLFARBIGEN RASSEN und ihre Sprachstaemme, Kulturen und Urheimaten. By Dr. FRITZ PAUDLER, Privatdozent at the German University of Prag. Pp. 271, price $1.75, Heidelberg, Carl Winter, 1924.

The Cro-Magnons, a race apparently of high development and intelligence, appeared in Europe some 25,000 B. C., and vanished about 10,000 B. C. They have reappeared in recent years and are growing more numerous and important with each new publication, until they may soon take the place of the Nordic as the center of controversy—which has perhaps been forestalled, however, by the assertion of Oscar Montelius that the Nordic is simply the Cro-Magnon, isolated and purified by millenia of life in Scandinavia.

Dr. Paudler, the latest contributor to the subject, will go farther. He describes two modern Cro-Magnon races, one in Northwestern Europe, to which he gives the name of Dalic race, and one in Southern Europe and Northern Africa (Berbers, etc.). The northern branch is taller and lighter, the southern shorter and darker, but still to be classed as a blond, Europe having now, under this scheme, three blond races, for the Nordic is still admitted to this noble company.

P. P.

MONGOLISM A CHEMICAL PHENOMENON

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SINCE the publication, in the JOURNAL OF HEREDITY of December, 1923, of my short article on the "Causes of Defective Children," in which some attention was devoted to the Mongolian type of feeble-mindedness, there has appeared in England and America a little book on this type of deficient human being, called "The Mongol in Our Midst," by Dr. F. G. Crookshank of London. This slender volume has created a pleasant furore, especially among laymen, for it is full of intriguing ideas and provocative reasoning in the field of human phylogeny, where every schooled man of today considers himself more or less at home. As one of the early investigators of mongolism, and as a shrewd and imaginative interpreter of data, Dr. Crookshank deserves all the attention his booklet has evoked, even if some of us will find a difficulty in following him into the realm of palmistry and phrenology.

Various considerations, not the least of them being Dr. Crookshank's expressed invitation of criticism and confirmative or contradictory contributions, lead me to set down here some facts with reference to the Mongolian feeble-minded in advance of a more extensive consideration of the whole subject in a book, the material of which has been gradually assembled in the course of more than twenty years. To understand the appositeness of what will appear here it is essential to set down some of the main claims or points of departure set forth by the British investigator and writer.

Dr. Crookshank, assuming the polyphyletic position in the matter of human descent, postulates three irreducible human stocks—white, yellow, and black, respectively derived from three primate stems and referred to as the chimpanzoid, the orangoid and the gorilloid stocks. In other words, the white races are supposed to have originted from an ancestry related to the chimpanzee, the Mongolian or yellow races from the orang and the Negroes from the gorilla.

He then sets forth the doctrine that mongolism occurring among the white races is an atavism to the orangoid stage of development. In support of this interpretation he makes the assertion that Mongolian idiocy or imbecility does not occur among true Jews, true Negroes or among the Dravidian population of India. It is confined to European whites, since they constitute the only race more advanced than the Mongolian and hence the only race from which there can be a regression to the Mongolian characteristics.

In order to avoid controversy I take the liberty of quoting. On pages 16-17 of the American edition will be found the following:

". . . there is absolutely no authentic account of any 'Mongolian' imbecile having been seen among a Negro population, *except when one or the other parent has been a 'White,' a racial Mongol or else of Hottentot descent.*" (The italics are his.)

On page 17, again, appears the following:

"We must conclude then, in respect

"PITHECOID PALMS" NOT A MONGOLIAN CHARACTERISTIC

Figure 14

It has been asserted that mongolian imbeciles have "pithecoid palms," in which the characteristically human lines are lacking. As a matter of fact, this seems to be a variable character; in some cases the lines are absent or greatly reduced; in others they are as distinct as in the normal human hand.

to the non-Mongolian peoples, that 'Mongolian' imbeciles are found only amongst the 'Whites.' They can be found among the Chinese, but no Mongolian imbecile has yet, so far as I know, been seen among the peoples of India who are free from all admixture of Mongolian races."

Again, on pages 17-18, is this:

". . . not one fully investigated case of 'Jewish' Mongolism has yet been reported. . . . Many European Jews are not pure racial Jews, but descended from the Mongolian tribe of Chazars, who after conversion to Judaism, founded the once powerful Chazar empire in southeastern Europe."

These claims set up a doctrine of the utmost importance to the riddle of mongolian feeble-mindedness, which has been studied, investigated and puzzled over with intense energy by whole groups of scientific men in the last generation and especially in the last ten or a dozen years. Since I have myself been occupied in this field for so long and since my findings are in direct opposition to those of Dr. Crookshank on the indicated points, I feel it necessary to outline some of my evidence and ideas without further delay, to the end that the trend of thought in this important field shall not swing too far in a false direction.

One of the most obvious attacks to be made on Dr. Crookshank's line of reasoning might have to do with the blunder of the biological notion that an atavism could carry a child of chimpanzoid stock back to an orangoid state

of development or line of characteristics. Fortunately, he covers himself here by arguing an admixture of Mongolian blood in the whites among whom this atavism occurs. He points out the various Asiatic invasions of Europe, the border intermarriages, the existence in Europe of whole nationalities of Mongol or Kalmuck inheritance and the like, all of which is plausible and beyond direct refutation. When, however, we take up the other important claims, we can find no such easy escape for the theorist.

My experience with mongolian feeble-mindedness goes back twenty years and covers the investigation and treatment of about two hundred and fifty cases of this form of mental deficiency. Most of these cases have been dealt with between 1911 and the present and at the Post-Graduate Hospital. Since, however, there is need of haste in the preparation of this writing, I have taken out of the files and had tabulated only one hundred of the most recent cases, in which the fullest possible investigations were made and the clearest data have been recorded. On this number of cases it will be quite as fair to base some conclusions as upon the entire two hundred and fifty, whose records will be worked up for my forthcoming book.

In considering what I shall say hereafter it is essential to remark that none of us can be clear or certain in the matter of racial purity. Neither the adherents of the hereditary school, to which Dr. Crookshank inclines, nor I, nor another, can venture out upon this thin ice without fearful trepidation. Which of us can say whether we have in hand a racially pure Jew or Negro or Caucasian? We certainly cannot make such affirmations in connection with the Jews and Negroes to be found in Europe or America or the West Indian islands, and it is doubtful whether we would be on much surer ground in Central Africa or in Palestine or even in Arabia. We are, thus forced back upon the calculation of probabilities, the chief support of science and of common sense.

Mongolism Among Negroes

First as to negroes. In the last fifteen years I have observed, investigated and treated eight cases of mongolian idiocy or imbecility among persons of African descent. In six of these cases the patients, as well as the parents, were distinctly black, showing no lessening of the characteristic African pigmentation and no reduction of the negro physical characteristics. As far as questioning and social investigation could disclose, there had been no white blood in any of these six families. In the other two, while the admixture of white blood could not be proved, there was apparently some lightening of the coloration and some other reasons for believing in mixed blood, though parents and, in one instance, grandparents denied it. We must, however, depend upon the characteristic appearance of the patient and parents rather than upon the answers given to questions, if only because of the obvious motivation of many falsehoods.

Among the one hundred most recent cases studied there occur only two negro mongolians, photographs of whom are published on another page.

I cannot, as I have said, assert with any degree of positiveness that these two or these eight cases of mongolism among negroes constitute examples of this abnormality among racially pure negroes. Indeed, I do not know whether such creatures exist. I do, however, assert that these cases are authentic, that they have been most elaborately investigated and that they apparently concern, in at least six cases, genuine negroes in whom no evidence of white blood or of Hottentot ancestry exists. Let me also call attention to the fact that eight cases of mongolism among negroes in New York city gives us about the proper proportion, counting two hundred and fifty cases as the total number observed by this writer, since the total population of

the city is about six millions and the number of negroes not greater than two hundred thousand.

Jewish Mongolians

When we come to the Jews we have a much more confounding state of affairs. Of the one hundred recent cases of mongolism treated by me and my assistants, cases belonging to the last five years or less, sixty-five are set down as Semitic, eight as Latin, eight as Celtic, four as Teutonic, two as Negro, two as Slavic, five as uncertain, only one as Anglo-Saxon. The others are scattering. (I need hardly call attention to the fact that there is much more Mongolian blood among Slavic peoples than among any other Europeans; yet we have only two cases of Mongolism among our Slavs.)

In examining these figures and ratios, it must be remembered that the Semitic population of the city of New York is somewhat less than one-third of the total, possibly not greater than one-fourth. Yet among my mongolian patients sixty-five per cent have been of Jewish parentage and this ratio will come very near to holding good for the entire two hundred and fifty cases observed by me in twenty years. It is also necessary to state that the clinic at the Post-Graduate Hospital attracts patients from all parts of the city and that there are no special reasons or hidden factors to explain the preponderance of Jews among our mongolians.

Once more, it is impossible for me to say that all or any of these New York City Jewish children are of pure Semitic blood. For all I know they may be, as Dr. Crookshank suggests, Mongolian Chazars. Yet many of them came from Asia Minor, some from Germany, some from France and England and the majority from Poland and Galicia. The probabilities of a preponderance of Chazar blood among them are, accordingly, not strong. I wish, however, to point out especially that far from "not one fully investigated case of Jewish mongolism" having been reported, here are sixty-five cases (not to speak of the older ones) in which the investigations have been carried as far as lies within human power.

In this matter I am, of course, in agreement with Dr. Feldman and others, whom the British writer seems to think unworthy of consideration. The photograph of a Jewish mongolian and her mother is reproduced to accompany the text.

Ancestors of Mongolians Appear Normal

I am also in disagreement with Dr. Crookshank upon two other points, which I shall not discuss here beyond the mere mention. He seems to believe that the parents or ancestors of mongolians commonly exhibit more or less marked mongolian characteristics. I have made the most patient and careful observations of this particular matter and I must state with the utmost emphasis that I have found this almost never the case. It is, at any rate, the rarest exception. Again, it is one of my distinguished colleagues' beliefs that mongolian idiots generally exhibit a pithecoid palm, showing an absence of certain lines which are peculiar to men and not found in the apes. I have also observed this matter and had many photographs of the palms of mongolian idiots and imbeciles taken. My experience is that some do and some do not exhibit this peculiarity. It is not a fact that the most deficient or lowest grade of mongolians reveal it any more than the others. I speak only of the cases I have seen, to be sure.

I hope it will be clear to my readers that my purpose in setting down these matters is not to discredit the work of a fellow physician and investigator in the same field, who deserves all praise for his labors and every credit for his theorizations which, even though they may be found faulty, were justified by the limited material and data at hand. The aim of science is to discover the truth, and this can only

MONGOLISM AMONG JEWS

Figure 15

The mother and two of her children are shown. The older girl is entirely normal, but the younger is a mongolian imbecile. The percentage of mongolians among mothers nearing the menopause is very much higher than at any other time during the child-bearing period, because of the disturbed condition of the endocrine glands at this time. Mongolian imbecile children of younger mothers can nearly always be traced to sickness or severe emotional disturbances during pregnancy. This causes an abnormal condition of the ductless glands, which results in the production of a defective child.

be accomplished by the well-known method of trial and error, of postulation and argument, of the comparison of data and findings. To this Dr. Crookshank himself invites.

Causes of Mongolism

The point at issue, however, is not whether one man or the other has misread the possibilities. What we really need to know is how these mongolian feeble-minded children come to be produced and what they are. I feel that the correct answer was given in my earlier article and wish only to reaffirm my opinion and to elucidate it.

When we come to explain the production of such abnormalities, such monstrosities as the mongolian idiots, we must choose one of two methods. The first is to adopt the ideas of the orthodox hereditarians. If we do this we must accept that all the main characteristics of the forthcoming individual are hidden in the germ plasm of the mother and father and that the whole nature of the offspring, all its better and worse characteristics, are determined in the ovum and spermatozoon. We must believe that, if a monster is born, his monstrosity was due to some involvement of the germ plasm of one or both parents, for this is the only way in which parental defects can be handed down and it is also, as I need hardly remind my readers, the only strictly correct definition of inheritance.

If we approach the matter of an atavism or ancient reversion from this point of view, we must conclude that there has lain hidden and inactive in the germ cells of many generations an evil something which, stirred by some mysterious influence, suddenly has awakened and caused an individual of a modern generation to slide far back down the phylum of its line. I must confess that I find all this a little too metaphysical. My adherence to the hereditarian doctrine cannot follow so far.

The other explanation, which I put forward in the article already referred to and often mentioned in earlier years, is not quite disregarded by Dr. Crookshank. Indeed, he says (page 83 seq.) that he was the first definitely to assert the correlation between a certain gland disbalance and mongolian feeble-mindedness. This explanation does not, however, seem to him sufficient, mainly for the reason, as he sets forth, that mongolian idiots are so much alike, show such a marked uniformity of characteristics and especially of physical stigmata. The specificity of mongolian idiocy seems to be the main foundation upon which the theory of a reversion to a mongoloid stock is based.

Now, without wishing to be at all unfair, it is necessary to point out that the specificity of pneumonia or tuberculosis or clubfoot or, to come nearer home, of hydrocephaly or Froehlich's syndrone or eunuchoidism means nothing of the sort and would be instantly rejected by any of my colleagues as evidence of a reversion to anything under the sun.

The truth of the whole matter, it seems to me, is that the mongolian feeble-minded child is the result of a glandular or chemical disbalance in the mother at the time of gestation and of nothing else whatsoever. This is borne out again by my calculations and observations.

Investigators in this field have, as I pointed out before, long recognized the fact that mongolian children were very often born to mothers nearing the climacteric of their lives, at which time the endocrine balance is known to be disturbed. My tabulation of one hundred cases shows that twenty-four of the mongolian children were born to mothers between the ages of forty and fifty years, which is an enormous proportion, considering the lowered fruitfulness and the comparative rarity of births among women of this age. If we consider the women between thirty-five and fifty we find that forty-eight or nearly half the mongolian children

were born to these women in whom the factor of approaching menopause is probably to be reckoned with. In the far more fecund years between seventeen and thirty-five my one hundred mothers bore only fifty-two mongolians.

Among these younger mothers, and the older ones as well, another line of inquiry was pursued in all my cases. Since the relationship between premenopause gland disbalance and mongolism was well known, could we find any competent evidence of the existence of comparable endocrine disturbances among the younger mothers? To this end careful inquiries were made of the mothers themselves, of the fathers, relatives, attending physicians, nurses and the like. We were at first surprised and then reassured to find that a very large proportion of these mothers were in highly nervous, overwrought, pathologically emotional condition in the course of their fruitage period. A number of others were found who had suffered, in the course of their pregnancy, from infectious and debilitating diseases, such as influenza, pneumonia, typhoid and the like. In all these cases, the most careful examination and inquiry directed to the conclusion that the exhaustion of these mothers affected the children through a disbalance of the endocrines. In my earlier article I exhibited a case of this kind with a photograph of the family. The exact computations of such data have still to be worked out. I hope to present them within a short time.

But, first and last, we were forced to conclude that mongolism is wholly dependent upon glandular balance, and of this, one evidence was the fact that the same mother and father, in any number of cases, produced both mongolian idiots of low order and perfectly healthy children showing not the slightest trace of mongoloid characteristics. The files at Post-Graduate will be found full of photographs and other evidences to support this claim. The orthodox hereditarian will explain, of course, that this is to be accounted for on the theory of the shuffling of the chromosomes or the possibility that a defective ovum or spermatozoon figured in the generation of the deficient child while sound germs chanced to unite for the production of the healthy children. And there is, to be sure, no definite and absolute way of disproving such theorizations.

But, when it can be shown, as is the case in many of the instances of mongolism studied and treated by me, that the mother was in sound health when she produced her normal children and suffered from gland disbalance when she carried her deficient offspring; and when it is the commonest observation that mongolian idiots are frequently born to older women, nearing the menopause, who previously had produced from one or two to a dozen normal children, then it must be clear that another explanation is more plausible. The truth seems to be that when in these families the normal children were born, the mother was in good health, whereas, in the course of her pregnancy with the unfortunate child, there was an emotional upheaval, attended by chemical disbalance, which alone caused the birth of the monster. It is also necessary to state that the cause of the emotional upheaval of the mothers who bore some of these mongolian children was accurately determined. Financial difficulties, with their attendant worries; grief over the death of near relatives; domestic storms, including desertion by the husband; the necessity of employment during the pregnant period and other similar causes were repeatedly found and in every case unmistakably verified. In these ways we were able to account for practically all of the mongolian children born to young mothers.

Action of the Hormones

Now as to the matter of uniformity or specificity in mongolians. Nothing is more clear to the modern endocrin-

NEGRO MONGOLIAN CHILDREN

Figure 16

In a total of 250 cases of mongolian idiocy, eight were Negroes. As far as could be ascertained, at least six of these were racially pure Negroes, though it is obviously impossible to establish this with entire certainty.

ologist than that the hormones of the various glands act selectively and that, therefore, any given type of disturbance or disbalance will produce an almost invariable effect. We need not go to the mongolians to observe this, for the far better understood cretins, whom we are now able to treat with almost infallible success by the administration of the proper gland extract, exhibit it quite as clearly and unmistakably. The cretins, like the mongolians, are invariably as alike as two peas in a pod. The only differences to be found in either of these types of deficients are mere matters of the degree of abnormality. But surely no one in this day will contend that the uniformity among cretins is evidence of an atavism to any point on the human phylum.

Again, just as we are able to make normal human beings out of the worst cretins, if they are taken in hand in infancy, by no other means than the constant feeding of the proper amounts of thyroid substance, so we are, to a lesser extent, able to help the mongolians by a similar method. The difference, great though it is at present, may be confidently asserted to be only that existing between a practically uniglandular and a pluriglandular disturbance. To put the matter another way, the cretin suffers fundamentally from a disturbance of the thyroid gland only, while the mongolian is affected by the disease or deficiency of several of the glands. In the case of the cretins we have found that simple feeding of the absent gland material will remedy the trouble, but we have not been able to get very direct or satisfactory results by the ingestion of some other gland substances, notably the pituitary and pineal. Again, we have not been able to find out exactly which glands are disturbed in the mongolian or to what degree. No laboratory tests have been evolved at present which can help us unriddle this mystery.

Yet, basing my assumption merely upon experimental feeding of the various gland extracts to many scores of mongolians treated in my clinic, I feel prepared to say that the wholly glandular nature of mongolism is well established and that, with such aid from laboratory investigators as is to be expected within the next few years, the mongolian idiot's secret will be discovered and he will be treated with something like the same success experienced in the cases of his endocrinological relative, the cretin. It is enough to say that in many of the cases of mongolism which I have handled the administration of ordinary endocrine substances has worked marked and sometimes even remarkable improvements. This is especially true in cases where the degree of abnormality was not too great.

Yet, though I hold that mongolism is wholly an endocrine matter caused by pre-natal chemical influences on the foetus, causing abnormal formative activity of the cells of the foetus, and that it is in no way connected with any inherited trend, while Dr. Crookshank feels that the thing is hereditary and explicable as an atavism toward the orangs, it need still not be felt that what I have said is a direct refutation of his main idea. We know that the gland equipment, and therefore the chemical balance, has been gradually evolved and modified all the way up the phylogenetic course from the primitive vertebrates. We know, too, that this chemical situation, controlled by the glands, has been the chief determinant of morphological changes and consequently of the evolution of new genera and species. While this evolution of the glands has been going on, a similar development of the germ plasm has also taken place, making it possible for the gradually improving creatures to perpetuate their advances by means of inheritance. All that the endocrinologist insists upon here is a recognition that the evolution of the glands has been at least as important as the evolution of the germ plasms. This is just the point at which the old-fash-

ioned hereditarian is not yet willing to meet him.

Thus, it is possible to play with the idea, in concluding, that mongolism, while it is not an atavism in the old-fashioned and to me more or less mystical sense, may yet be a reversion, through external or environmental causation, to a glandular or chemical situation peculiar to an orangoid stage of human development. It is true, this still leaves such things as the negro mongolians unexplained, if we are to consider them as descended from another ape stem, but we may amuse ourselves with the fancy. The race will, however, derive more benefit from the investigation of the chemical origin of mongolism and a search for a way of treating the affected glands.

Human Zygosis

MONOGRAPHIEN UEBER DIE ZEUGUNG BEIM MENSCHEN, by DR. MED. HERMANN ROHLEDER, Sexualarzt in Leipzig. Band I, Normale, pathologische, und kuenstliche Zeugung (3rd edition); Band II, Zeugung unter Blutsverwandten (2nd edition); the two bound together, pp. 347, price $2.45. Leipzig, Verlag von Georg Thieme, 1924.

Dr. Rohleder has brought together an immense amount of information, but he is not wholly critical or modern in his handling of it. The latter defect is especially evident in such parts as the pathological section (dealing with the inheritance of disease) and with the section on consanguineous marriage. A few of h. errors are really surprising, as when he says that the English name for incest is "bloodshed" (German, Blutschande). While the work is not a safe guide for those unfamiliar with the field it covers, it offers to those capable of using it carefully greater quantity of material than any other single volume on the subject known to me. *P. P.*

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IDIOTS AS REVERSIONS

Mongolism and Other Abnormalities Ascribed to Racial Interbreeding

A Review

"THE Mongol in Our Midst" is a small book that may open more lines of argument in the discussions of race evolution that are now so actively going on. The author, F. G. Crookshank, is introduced by the wrapper as "a very well known and successful English hospital doctor." Mongolian idiocy is ascribed to racial interbreeding and is treated as a present cause of race degeneration, not as a "Yellow Peril" of the future. To write an interesting and readable account of such a subject is a distinct achievemer' The reader is allowed to share the thrills of the various discoveries and conjectures to which the author's studies have led. A book may be called iconoclastic that would change all the Buddha images in the world from objects of religious veneration to symbols of degeneracy. Sitting in the Buddha-posture, with the legs folded transversely in front of the body, is described as one of the atavistic characters of Mongolian imbeciles.*

Regarding the idiots and defective children, Dr. Crookshank evidently has the qualifications of an experienced investigator, and in his view "Mongolian" characteristics are not confined to inmates of hospitals and asylums, but are of frequent occurrence among normal or nearly-normal people in England, France and other European countries. Such tendencies to Mongolism must be extremely prevalent in the mixed population of the United States, if the Crookshank theories are well grounded.

Though account is taken of many anatomical features, the treatment is largely untechnical, with directness and brevity of statement that are very effective. Many readers are likely to be convinced that a relation exists between the racial characters and the abnormalities of reproduction. Whether the general argument appears credibly established or not, interest is likely to be aroused that will lead to more intensive study. Many facts of reversion could be drawn from other branches of biology to support the idea of reappearance of characters of remote ancestors in defective individuals, especially among hybrids, and there can be no doubt that the human stocks are very extensively hybridized.

Two Kinds of Hybrids

The degeneration of hybrid stocks is a phenomenon that should be better known to students of racial biology. Many writers are proposing to improve the race by hybridizing, while others are warning against degeneration through racial interbreeding. Most of the confusion is due to the failure to distinguish between two classes of hybrids, conjugate and perjugate, which often show entirely different effects. The first generation, consisting of conjugate hybrids, may appear to be equal or superior to the parents, while the second and later generations of the same stock may show many weak and sterile individuals, so that a population of perjugate hybrids is far below the standards of the parent groups. Even with an intermediate, uniform and productive conjugate generation, many diversities and abnormalities may appear in the perjugate generations.

*The Mongol in our Midst, a Study of Man and his Three Faces, 123 pages, 51 plates and figures, and a bibliographic reference list of 10 pages, 1924. Published by E. P. Dutton & Company, 681 Fifth Avenue, New York, price $1.50.

No doubt the reason for defects appearing in the perjugate generations is that hybrids produce inferior germ-cells, often to the extent of complete sterility, as in the mule. The conjugate hybrids are formed from normal germ-cells of the parent stocks, while the perjugate generations develop from hybrid germ-cells, many of which are defective or abnormally diverse. If the hybrid germ-cells are not too defective, conjugation takes place and development begins, but may not be carried through to a normal expression of the characters of either of the parents. Degenerating cotton hybrids, for example, show many abnormalities some of which may be reversions to primitive characters. "A new creation" is supposed to result from crossing, though most of the wide variations must be classified as defects, from a biological standpoint. Such a character as seedlessness, for example, seems more likely to be a defect than to be a reversion, though a seedless plant may serve as a pollen-ancestor, and seedlessness appears as a normal character in plants that are dioecious.

The theory of unbalanced secretions of the growth-glands as a factor in the production of idiots, as presented recently in the Journal of Heredity by Dr. Schlapp, is recognized by Dr. Crookshank, but the point is made that a further explanation is required to account for the abnormal characters appearing in the definite combinations that have made it possible for the idiots to be classified by analogy with racial differences. How the idea of such a classification developed in the minds of previous observers is traced and illustrated in an interesting chapter.

In relation to heredity, the different views are not really in conflict, but may give mutual support. The lack of growth gland secretions necessary for a normal development may leave the embryo at a stage where primitive characters are shown. With development halted at the same stage, the same complex of primitive characters would appear, as in the Mongolian idiots. Such reversions need not be thought of as "throw-backs," in a sense implying changes of transmitted characters, but rather as "stay-backs" on the course of development, with the normal characters not brought into expression.

The strongest claim for inheritance factors in Mongolism is a statement on page 81, "I would go further and say that I have never seen a Mongolian imbecile of whom one or both parents were not clearly Mongoloid and that, when both parents show signs of Mongolism the Mongolian children are more than usually resemblant to racial Mongols." If the distinctive characters of Mongolism can be formulated and recognized, avoidance of this form of idiocy may become a feature of practical eugenics. With the question opened to general observation, the facts will be established or the statement discredited. Undoubtedly the study of heredity will be popularized if such applications to the human species begin to be made.

Three Human Species

Analysis of the racial characters is based on the assumption of three primary species of the genus Homo. These are considered as widely different and are associated with the three anthropoid stocks that still exist, the Mongolian race with the orang-utan, the Negro race with the gorilla, and the White race with the chimpanzee. The traditional monogenetic view of human evolution is thrown aside and the alternative doctrine of polygenesis is defended. Confirmation is sought in the work of Klaatsch and other recent investigators of the relationship of the living apes to the primitive human races and to the several fossil anthropoids that paleontologists have discovered in recent years. There seem to have been many localized types of apemen, as of primitive people who still exist.

Dividing humanity into a few races is convenient for purposes of description, but the failure to find any defi-

nitely diagnostic characters is an indication that the racial groups are artificial. The theory of hybridism has served conveniently to explain the intermediates, though it may well be doubted that any stable human type is of hybrid origin.

Postures and Races

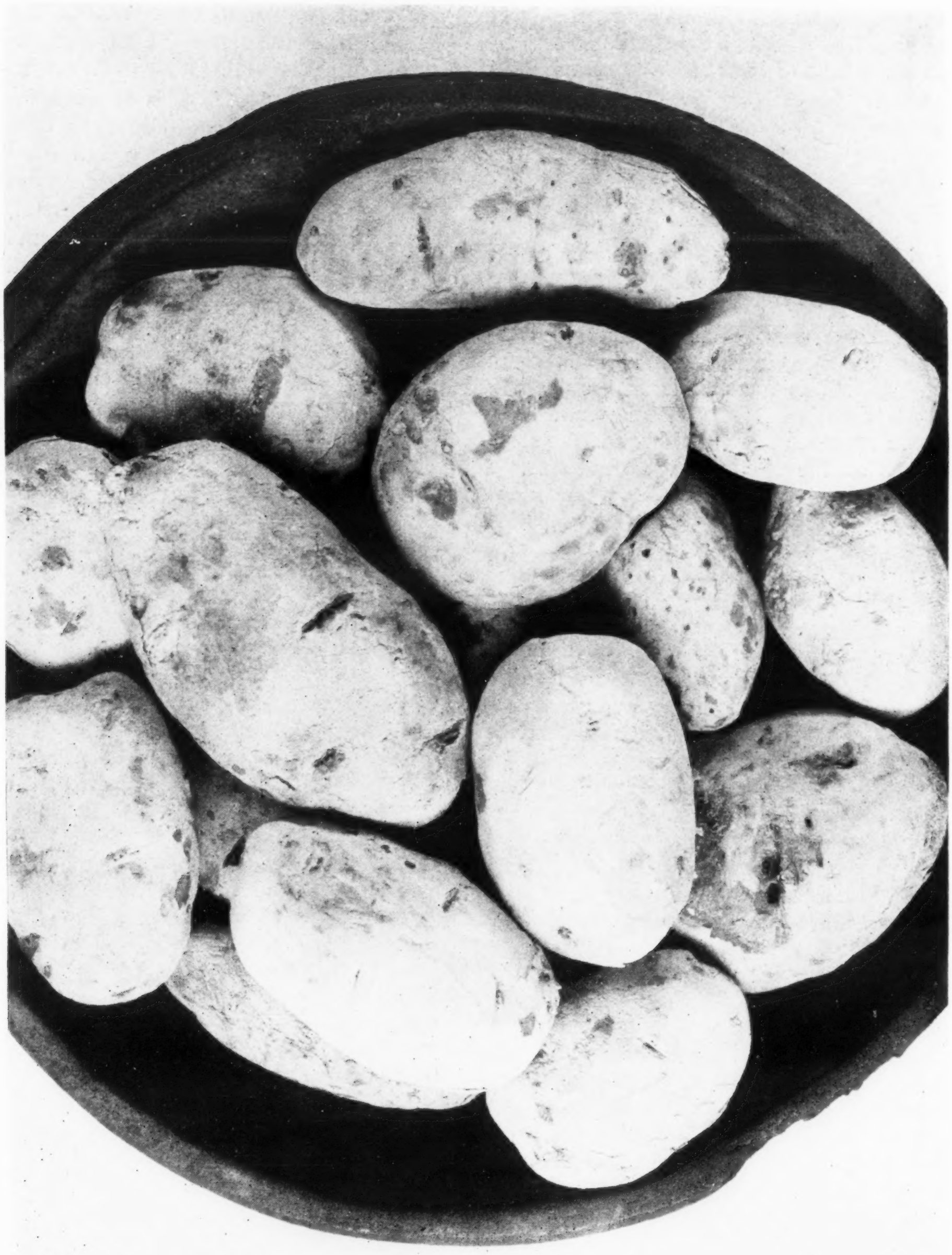
Undoubtedly there are examples of strikingly simian or orang-like features among some of the inhabitants of Southeastern Asia, as in some individuals of the European and African races. Crookshank dwells especially upon the Buddha-posture as indicating a fundamental difference in the leg-bones of the Mongolian race, but such an argument may easily lead to confusion. With that posture established widely by religious sanctions, the leg-bones of different races might show similar modifications. Effects of squatting or other habitual postures are recognized in the gaits of people who follow different occupations. The lax physique and apathetic mentality that Crookshank would associate with the Buddha-posture may have belonged to some other racial stock, rather than to a Mongolian people. The simian facial resemblances and the leg-bone characters may or may not have been derived from the same racial stock.

The Chinese use chairs, while the Japanese sit on their heels like American Indians, instead of folding the legs forward like the Hindoos. There are many negroid and primitive white stocks in Asia to complicate the race questions, as well as Mongoloids in Europe. The Australians, Dravideans, Papuans, Melanesians, Negritos, Ainus, and other submerged peoples of eastern Asia make it doubtful whether the Malays or other Mongoloids were original inhabitants, either of the East Indian islands or of the Asiatic mainland. It is not impossible that the Mongolian type developed in America rather than in the Old World.

Why it is necessary to attach the three-ape idea to the study of Mongolism is not clearly brought out. Mongolism is said not to occur among Negroes, but this is claimed as well for the Jews and the Hindoos. It is intimated that microcephaly and dementia praecox may be negroid atavisms, comparable to Mongolism, but common descent and parallel variation in the racial group would account for many resemblances, both in normal and in abnormal characters. Apparently the facts would argue as well if two primary race-types straight-haired and curly-haired were assumed, instead of three, or if the reversions to primitive characters were ascribed to crossing of different varieties of the same species, as when ancestrally colored blue pigeons result from the crossing of two white varieties.

The general occurrence of Mongolism among European peoples is ascribed to the incorporation of a prehistoric Mongolian population, as well as to Mongolian invasions and infiltrations in the historic period. Also the Mediterranean race is considered as possibly of Malay extraction, a suggestion adopted from Hose, who made a very careful study of the Malays of Borneo. It must be admitted that the physical characters of the Mediterranean type are not very different, while there are many suggestive similarities, including the prehistoric lake-dwellings of Southern Europe, built on piles like Malay villages. A highly developed agricultural and maritime civilization is known to have existed in Crete in the pre-Hellenic, megalithic age. The peculiar military and eugenic system of the ancient Spartans, idealized by Plato in *The Republic*, was introduced by Lycurgus from Crete, according to the ancient tradition, and the laws of Lycurgus show many analogies with the social systems of the Malays and Polynesians. Thus the suggestion of Malay antecedents for the ancient Mediterranean civilization is not so fantastic as it might appear, and the extent of racial admixture in Europe may be even greater than has been supposed.

O. F. Cook.



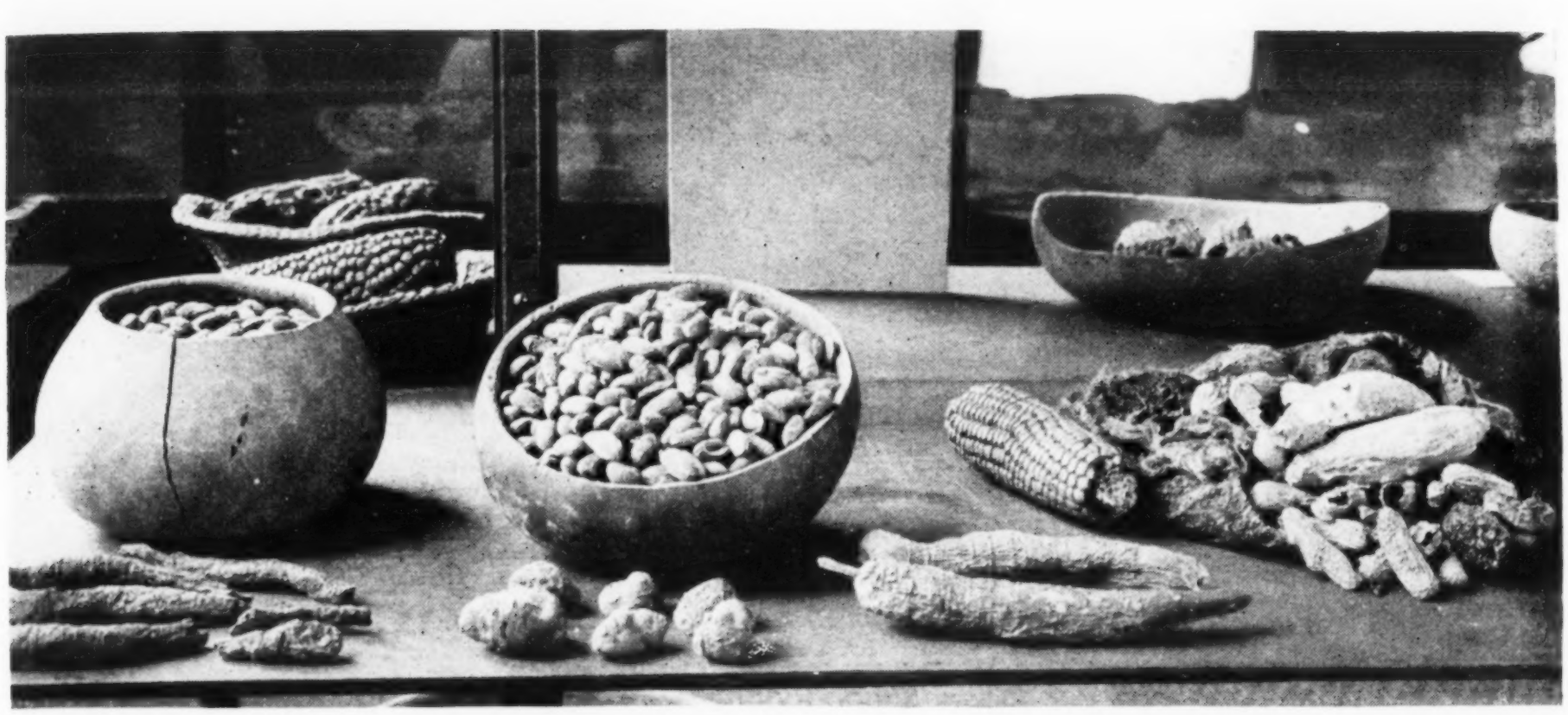
MORAY OR "WHITE CHUNYO"

Figure 17

Potatoes frozen, dried, trampeled, soaked in water and dried again. Specimens in U. S. National Museum collected by Mr. O. F. Cook, U. S. Department of Agriculture.

THE POTATO OF ROMANCE AND OF REALITY

II. The Potato of Reality



ANCIENT FOODS FOUND WITH PERUVIAN MUMMIES

Figure 18

Food Staples found in Pre-Columbian graves of the coast of Peru, including several varieties of beans (*Phaseolus vulgaris*) lima beans (*Phaseolus lunatus*), manioc (*Jatropha manihot*), maize (*Zea mays*), peanuts (*Arachis hypogaca*), sweet potatoes (*Ipomoca batatas*) and *chunyos*, or dried potatoes. The latter in the central foreground. Original photograph of specimens in the American Museum of Natural History, New York.

WRITERS on the origin of cultivated plants, who for their information depend upon the accounts of early travelers, missionaries and colonists, are apt to be mistaken in their identification of species. Many of these accounts, written by persons ignorant of botanical relationships or the essential features by which genera and species may be distinguished, give little indication of the true nature of the plants they describe. Thus, as I have already shown, Heriot's account of the *openauk*, of which he described only the tubers and the habitat, caused it to be confused for more than three centuries with the potato. From the account of the botanist Kalm, who speaks of its bean-like pods, we know at once that the plant belongs to the Leguminosae. Even botanists have disputed for years the origin of several well-known plants, including beans, peanuts and squashes, owing to the resemblance of certain species of the Old World to those of America. At the present time the majority of laymen have not the slightest idea that the common beans of America are quite distinct from the classic *faba* of the Romans; and botanists confuse the American peanut, *Arachis hypogaca*, which found its way to Africa at a very early date, with the African ground-pea, *Voandzeia subterranea*, whose vernacular names were transferred to it. Translators of early French and Spanish narratives have mistaken sweet potatoes for yams, and American squashes and pumpkins for melons of the Old World, whose common names were used in the reports of early explorers on account of their superficial

Figure 19

A funeral vase in the form of two potatoes in natural colors from a grave at Chimbote, on the coast of Peru, collected by W. E. Safford, 1892. Field Museum, Chicago, No. 1188.

Figure 20

Black ware vase from a Chimbote grave, in the form of a conventionalized potato. Collection of Spencer F. Baird, U. S. National Museum.

POTATO VASES

resemblances. The statement that peas were encountered in North America led to much confusion, but it is evident that this name was applied to certain varieties of beans (*Phaseolus vulgaris*); for Heriot explains that the colonists of Roanoke Island called the pulse known to the Indians as *wickonzour,* "peas," to distinguish them from beans, which they closely resembled, but from which they differed in their smaller size; and Beverly states that the Virginia Indians sowed peas between the rows of corn in their plantations.

Another persistent mistake is that which attributes an American origin to the banana, accepted by Prescott on the authority of Humboldt, who drew his conclusions from the accounts of early Spanish-American writers with little knowledge of plants; one of them, the patriotic but unreliable Garcilaso de la Vega, descendant of the Incas, who made many extravagant and baseless claims for what he deemed the glory of his native country; another, Padre José de Acosta, a classic scholar, lavish in references to Old World authorities but with little real knowledge of plants, who compared the fruitful platano, or banana (*Musa sapientum*), with which he was familiar, to the Old World plane-tree (*Platanus orientalis*) of classic writers, planted not for its fruit but for the shade of its leafy branches. That bananas and plantains had been important food staples in Asia, Africa and Polynesia for centuries before the discovery of America, was apparently unknown to him.[1]

Testimony from Prehistoric Tombs

Fortunately for a knowledge of the economic plants of Western South America we do not have to turn to literature. Along the arid desert which

[1]See Jose de Acosta, Historia Natural y Moral de las Indias, Lib. 4, Cap. 21, 1590.

CONVENTIONALIZED POTATOES

Figure 21

A whistling *huaca* of black ware, in the form of conventionalized potatoes from a Chimbote grave. Collection of Spencer F. Baird in U. S. National Museum.

forms the Pacific coast of Peru and northern Chile there is a succession of cemeteries in which mummies are found accompanied not only by desiccated plants and plant-products, but also, in many cases, by funeral vases of terra-cotta, some of which represent food staples and fruits of the ancient inhabitants. Owing to the absence of rain in this region the soil remains impregnated with sodium nitrate which has acted as a preservative of organic material, so that even in ancient refuse heaps on the surface as well as in the tombs, both vegetable and animal substances have been preserved in a remarkably perfect condition. Among the plant products and representations of fruits and vegetables dug up by the author in Peru, the most common were maize and maize gods, beans (*Phascolus vulgaris*) both round and kidney-shaped, lima beans (*Phascolus lunatus*) shaped somewhat like the Old World broad bean or faba, several varieties of squashes (*Cucurbita pepo*), round and crook-necked, smooth and warty, and hardshelled gourds (*Cucurbita laginaria*) used as containers; coca leaves in beautifully woven bags of llama wool suspended from the necks of the mummies and accompanied by lime in small gourds; peanuts so perfect that they might have been buried yesterday; manioc or mandioca roots and graters for rasping them; the thick dichotomous roots of *Canna edulis* often represented

DRYING POTATOES FOR "CHUNYO"

Figure 22

View of the elevated Peruvian Collao, showing Quichua Indians preparing Chunyo. Photograph received from the Hon. Hiram Bingham. See National Geographic Magazine, April, 1913, p. 568.

in the form of a terra cotta funeral vase with or without a human head in bas-relief on the main root; and—most interesting of all—*Solanum tuberosum*, the *papas* of the Quichuas, either dried or represented in terra cotta, sometimes as fac-similes of the original tubers, but more often conventionalized in black or red pottery.[2] Dried potatoes were found by the author in graves at Arica, on the coast of northern Chile, in 1887, together with arrow points and llama-drivers' slings from the elevated plateau about Lake Titicaca. Terra cotta huacas, or funeral vases, representing potatoes were most abundant in graves near Chimbote and Chepen, northern Peru. In the accompanying illustrations Figure 18 shows a collection of food products from pre-Columbian graves in the New York Museum of Natural History; Figure 19 is a funeral vase from Chimbote representing two potatoes in natural colors; and Figure 21 shows a vase of black ware from the same locality, in the form of conventionalized potatoes. *Solanum tuberosum* can not be cultivated successfully at low elevations in the tropics, so that the potatoes which were evidently an important food staple of the early inhabitants of the Chimbote region, must have been brought down from the nearby mountains. These dried potatoes and representations of potatoes were certainly interred with the dead in pre-Columbian times. They are the most ancient illustrations of potato culture in existence.

True History of the Potato.

The first published account of *Solanum tuberosum* is that of Pedro de Cieza de Leon, who, in 1538, encountered it in the upper Cauca valley between Popayan and Pasto, in what is now Colombia, and afterwards at Quito, now the capital city of Ecuador. At that time he passed through villages so high above sea-level that maize would not grow in their vicinity, where the principal food crops mentioned by him were *papas* and *quenoa* (the minute seeds of *Chenopodium quinoa*), both of which are still the most important foods

[2]See SAFFORD, W. E. Food Plants and Textiles of Ancient America, in *Proceedings of the 19th International Congress of Americanists*, pp. 12-30, 1917.

of the mountains and elevated plateau of western South America.

In his *Chronica del Peru*, a journal written from night to night while his comrades were sleeping, Cieza de Leon describes the *papas* as "a kind of ground-nut, which when boiled becomes as soft as a cooked chestnut, but which has no thicker skin than a truffle." Afterwards, in writing of the elevated Collao region, he speaks of it in greater detail. The inhabitants of that part of the world live in villages surrounded by cultivated fields: "their principal sustenance is *papas*, which as I have already stated in this history are like *turmas de tierra*. These they dry in the sun and keep from one harvest to the other. And they call this *papa* after it is dried, *chuno;* and among them it is esteemed and held precious: for they have no ditches like many others in this kingdom to irrigate their fields; and if there is a dearth of natural water to make their crops grow they suffer from lack of food and work, unless they are provided with this sustenance of dried *papas*. And many Spaniards have become rich and returned to Spain prosperous only from carrying *chuno* to sell to the mines of Potosi."[3]

Cieza also describes the great sandy desert along the Pacific coast traversed at intervals by ribbons of verdure, where streams from the Andes make their way seaward, not always, however, reaching their destination. In this region he was much impressed by the numerous cemeteries to which I have already referred, and by the vestiges of cultivated fields which, even at that early time, had long been abandoned, and whose ancient tillers were sleeping in the adjacent tombs.

Cieza's *Chronica*, first published in folio at Seville in 1553, was followed the next year by a small size edition printed at Antwerp by the famous publisher Jan Steeltz and by a third, in Italian, printed at Rome in 1555. It was eagerly read as the first authentic account of South America.

Padre José de Acosta, a Jesuit missionary, who was in South America from 1571-1576, was the next author to treat of the Peruvian *papas* which he observed in their original habitat. After writing of yuca or manioc in his account of the edible roots of the New World, he says: "In the elevated region of the Sierra of Peru and the provinces which they call the Collao, composing the greater part of that kingdom, where the climate is so cold and dry that it will not permit the cultivation of wheat or maize, the Indians use another kind of roots which they call *pappas*, a kind of *turmas de tierra* that send up scant foliage (*cchan arriba una poquilla hoja*). These *pappas* they collect and leave in the sun to dry well, and breaking them they make what they call *chunyo* which will keep for food in that form many days and serves them for bread; and of this *chunyo* there is great commerce in that kingdom with the mines of Potosi. *Pappas* are also eaten fresh either boiled or roasted; and from one of the mildest varieties which also grows in warm situations they make a certain ragout or *cazuela* which they call *locro*. Indeed, these roots are the only wealth of that land, and when the season is favorable for the crop they [the Indians] are glad; for many years the roots are spoiled and frozen in the ground, so great is the cold and bad climate of that region."

In preparing *chunyo*, potatoes were subjected to freezing as well as drying. The process is described in detail by Padre Bernabe Cobo, who writes as follows: "The tubers are gathered at the beginning of the cold season, in May or June, spread out on the ground and exposed for a period of twelve or fifteen days, to the sun during the day and the frost at night. At the end of this time they are somewhat shrivelled, but still watery. In order to get rid of the water they are then trampled upon and then left for fifteen

[3]Parte primera de *La Chronica del Peru*—Hecha por PEDRO DE CIEZA DE LEON, Antwerp edition, p. 243. 1554.

or twenty days longer to the action of the sun and frost, at length becoming as dry and light as a cork, very dense and hard, and so reduced in bulk that from four or five fanegas of fresh tubers there results only one fanega of *chuñyo*. Cobo adds that *chuñyo* thus prepared, will remain unspoiled for many years and that the Indians of the Collao provinces eat no other kind of bread. A choicer and more highly prized quality is prepared by soaking the tubers in water for about two months, after their preliminary drying. They are then taken out and dried in the sun once more. This quality of *chuñyo*, which is chalky white within, is called *moray*. From it a kind of flour, finer than wheat flour, is prepared by the Spanish women, who use it for starch, biscuit, and sweetmeats of all kinds, like those confections usually made with sugar and almonds."[4]

In the economic herbarium of the United States Department of Agriculture are specimens of *chuñyo* from ancient coast graves, and in various museums of ethnology in America and the Old World there are *huacas*, or funeral vases, representing tubers of *Solanum tuberosum* similar to those I have already described. The accompanying illustration, Figure 22, for which I am indebted to the Hon. Hiram Brigham, shows the elevated Peruvian Collao with piles of potatoes and Quichua Indians preparing *chuñyo* exactly as they did at the time of the visits of Cieza de Leon, Acosta and Padre Cobo. Figure 17 is an original photograph of *moray*, or white *chuñyo*, in the U. S. National Museum, collected by Mr. O. F. Cook, of the Bureau of Plant Industry, between Sicuani and Santa Rosa, on the road from Cusco to Lake Titicaca.

Potatoes Cultivated by the Indians of Southern Chile

In November, 1578, Sir Francis Drake encountered tubers of *Solanum tuberosum* in use as a food staple by the Indians of Southern Chile, where they are still extensively cultivated. Their occurrence at sea-level in this part of South America is not singular, for, as all students of plant distribution well know, many species characteristic of the Andean vegetation thrive at altitudes lower and lower as they extend southward, reaching sea-level in the region of the Chonos Archipelago and the Straits of Magellan. Within less than a decade after Drake's visit, these tubers had become a regular food on Spanish ships. On March 16, 1587, Thomas Cavendish, stopping at St. Mary Island, near Concepcion, Southern Chile, found "Cades of strawe filled with potato rootes, which were very good to eat, ready made up in the storehouses for the Spaniards, against they should come for their tribute." At this very early date, less than a century after the discovery of America, Cavendish found wheat and barley in cultivation in Southern Chile, and "Hogges and Hennes" had also been introduced. "The Indians of this Island," said Master Francis Pretty, who wrote the narrative of the voyage, "are held in such slavery by them [the Spaniards] that they dare not eate a Henne or an Hogge themselves. But the Spaniards have made them all in that Iland Christians. Thus wee fitted ourselves here with corn as much as wee would have and as many Hogges as wee had salt to powder them withal, and great store of Hennes, with a number of Bagges of Potato rootes, and about 500 dried Doggefishes, and Guinie Wheat which is called maiz [by the Spaniards]. And having taken as much as wee would have, yet wee left great store behind us. Our Generall had the two Principals of the Iland aboard our Ship, and provided great cheare for them, and made them merry with Wine: and they in the end, perceiving us to be no Spaniards, made signes as neere as our Generall could perceive, that if wee would goe over unto the Maine Land unto Arauco that there was much gold, mak-

[4]Cobo Bernabo, Historia del Nuevo Mundo (1653) 1: 361. 1890.

ing us signes that wee should have great store of Riches."[5]

Sailing northward, looting the coast towns as he went, Cavendish captured the Santa Anna, the Spanish "admirall," or flagship, off the coast of Mexico, taking from her three young Filipinos, "borne in the Isles of Manilla," also a Spaniard, whom he caused to be hung, after being piloted by him from the Mexican coast to Guam and the Philippines. The "potato rootes" he encountered in the latter islands were not *Solanum tuberosum*, but sweet potatoes, *Ipomoca batatas*, easily recognizable by their Aztec name *Camote*, which had accompanied them from Mexico, and which they still bear in those islands.[6]

Cavendish, like Drake, returned to England around the Cape of Good Hope. Whether he brought back potatoes with him is not known, but it is quite certain that it was not he who introduced them into Europe; for he arrived at Plymouth the 9th of September, 1588, and more than eight months before this, on Jan. 26, 1588, Charles de L'Ecluse, or Carolus Clusius, at that time in charge of the Botanical gardens of Rudolph II, at Vienna, received from Philippe de Sivry, Prefect of Mons in the Belgian province of Hainault, two potato tubers which he planted in his garden. These had been sent to de Sivry by an attache of the Papal Legation, who had them from Italy, where they had been in cultivation since about 1585. The year following, de Sivry sent to Clusius an excellent colored drawing, now in the Plantin-Moretus Museum at Antwerp, which bears the following inscription in the handwriting of Clusius:

"Taratoufli a Philippo de Sivry acceptum Viennae 26 januarii 1588.—Papas Peruanum Petri Ciecae."

This drawing is reproduced in the accompanying illustration, Figure 23 Its accuracy is shown by comparing it with Figure 24, an original photograph of a specimen in the Economic Herbarium of the U. S. Department of Agriculture, propagated from a tuber collected at Oruro, Bolivia, by Mr. W. F. Wight (No. 415).

At the time the drawing was made an interest in the potato was awakened by the appearance of Acosta's account of the New World, published first at Salamanca in Latin in 1588-89, and the following year at Seville in Spanish, under the title *Historia Natural y Moral de las Indias*. Acosta dedicated his work to "La Serenissima Infanta, Dona Isabel Clara Eugenia de Austria."

It seems strange that a nourishing and easily cultivated food staple like the potato, to whose excellence both Cieza and Acosta had called attention, should have to wait so long for recognition. Other cultivated plants of the New World like maize, beans and tobacco, became widely spread in a remarkably short time after the discovery of America.

The exact date of its introduction into Europe is not known. It was, however, undoubtedly carried thither from Peru as a curious food of the New World, possibly by the same Spaniards

[5]See "The Third Circumnavigation of the Globe; or the Admirable and Prosperous Voyage of Master Thomas Candish. * * * Begun in the Year of our Lord 1586 and Finished in 1588." In Purchas His Pilgrims Vol. 2: 149-185. Edition of 1905. Among the Old World plants successfully introduced upon the Pacific coast of tropical America, Cavendish found at this date, on the island of Puna in the Gulf of Guyaquil, melons, cucumbers, radishes, rosemary, thyme, and, growing in an orchard, "orenges sweete and sower, limmons, pomegranates and lymes, with divers other fruits." There were also on this island "many horses, oxen, bullocks, sheepe, very fat and faire, great store of goates which be very tame and are used continually to be milked." From the Philippines coconuts had been brought by the Spaniards to the coast of tropical Mexico and Central America, and with them had come Filipinos who taught the Spanish colonists the process of fermenting *tuba* from the sap obtained by slicing the tips of the immature inflorescences.

[6]Camotes, or sweet potatoes, are the principal food crop of the hill-tribes of Northern Luzon, where they are extensively cultivated on terraced hillsides. It is declared by the natives that their fathers always possessed them.

OLDEST DRAWING OF THE POTATO

Figure 23

Drawing received by Charles de L'Ecluse from Philippe de Sivry, Jan. 26, 1588. The earliest European illustration of the potato. Original in Plantin-Moretus Museum at Antwerp.

A MODERN POTATO

Figure 24

Herbarium specimen of *Solanum tuberosum* and tuber from which it was grown. Collected by Mr. W. F. Wight at Oruro, Bolivia.

who, according to Cieza, returned to Spain after having grown rich by carrying *chunyo* to the mines of Potosi.

Due to Clusius' delay in publishing his data, he was anticipated by Gerard, who was indebted to him for information regarding the potato, as stated in his Herbal. It was not Gerard who gave to the potato its accepted botanical name, but Kaspar Bauhin, who, in 1596, described it accurately under the very appropriate name, *Solanum tuberosum*, which Linnaeus adopted.[7]

Like Clusius, Bauhin identified it with the *papas* of Spanish-America. His illustration was made from a specimen grown in the garden of Dr. Scholtz at Breslau, in Silesia, to which I shall refer later. Clusius' description, although antedating the publications of Gerard and Bauhin, did not appear until 1600.[8]

The final number of this series will tell of the introduction of the potato into Europe and North America as a food staple and of the various species of tuber-bearing solanums which have been confused with *Solanum tuberosum*.

[7]See KASPAR BAUHIN, *Phytopinax, seu Enumeratio Plantarum*. 302. Basil. 1596.
[8]CLUSIUS, *Rariorum Plantarum Historia*, lib. 4. p. 78, 1601.

The Quantitative Character of Sex

SEXUALPATHOLOGIE, by DR. MAGNUS HIRSCHFELD. 3 vols. (211, 279, and 338 pp.) complete, $7.50. A. Marcus and E. Webers Verlag, Bonn, Germany.

The director of the Institute for Sexual Research in Berlin has brought together in these three illustrated volumes an immense amount of data on sexual pathology, with the object of furnishing a textbook for physicians and students. It may perhaps be said fairly that the fundamental problem in this field is whether the various perversions and deviations from normal sexual development are organic in origin, or merely functional and psychological. Against a modern school which supports the latter alternative, Dr. Hirschfeld has consistently advocated the former, and the development of studies of glandular changes in recent years has gone far to bear him out. While the quantitative theory of sex has long been thoroughly established, investigations of various phases of it form one of the most important parts of recent experimental zoology. The material assembled by Dr. Hirschfeld forms a valuable complement, on the human side, which special students can not afford to overlook. *P. P.*

ZEA MAYS GIGAS

A Strain of Native Gigantic Maize

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IN THE summer of 1921 there appeared in the third inbred generation of a strain of maize a single *gigas* type of plant in a progeny of 110 plants. This plant, with its stout culm and unusually broad, thick leaves, made a striking comparison with its sibs and other plants that were growing in the experimental field. It grew to have an ultimate height of about seven feet, and its leaves from below the ear shoots to the tassel were between six and seven inches wide. In length the leaves of the gigas plant only slightly exceeded the leaves of its normal sibs. When rubbed between the thumb and forefinger the large leaves gave one the impression that they were thick and leathery, somewhat like the leaves of the rubber plant (*Ficus elastica*, Roxb.). The greater vigor of the gigas plant was also expressed in its deep green color and in the development of two unusually large ears. One of the ears was self-pollinated and the other one was used in making a reciprocal cross with a normal plant in an unrelated strain. The tassel produced an abundance of pollen and a large number of outcrosses were made.

Origin and Nature of the Gigas Character

The strain in which the gigas plant appeared was homozygous for the *argentia* chlorophyll pattern and originated from a field of maize grown in eastern Pennsylvania under the varietal name of "mastodon." Inasmuch as the gigas plant had argentia leaves as well as the other characters peculiar to the strain, there can be little doubt that the plant arose as a genetic variation in the strain and was not a volunteer plant from some other and unknown source. The following year a duplicate planting was made of more than 200 kernels from the same ear which gave rise to the gigas plant, but no additional plants of the gigas type were found.

A cytological study of the root tips made by Miss Thelma Gilbert in the laboratory of Dr. W. B. R. Robertson of the Department of Zoology, University of Missouri, indicates that the gigas plants have twenty chromosomes as their 2n number. This study, together with the absence of sterility in hybrids between gigas and normal plants, would seem to indicate that the gigas character is not due to chromosome duplication.

Inbreeding the Gigas Type of Maize

The gigas strain has been inbred continuously since its occurrence in 1921, with certainly no very marked reduction in vigor. The gigas plants grown in 1924 represented the sixth generation of inbreeding for the strain. The plants had the uniformity that we have come to expect of inbred strains, but were remarkably vigorous.

A single row of the gigas plants were grown on the experimental grounds of the Missouri Agricultural Experiment Station in the summer of 1924. The plants in this row were exceedingly uniform as to height, number of leaves, size and texture of leaves, number of ears produced, branching of the tassel, the beginning and duration of the shedding of pol-

*The investigation here reported was made, in large part, in the Department of Field Crops, University of Missouri Agricultural Experiment Station.

A GIGAS PLANT

Figure 25

A typical gigas plant in a strain which has been inbred for six generations. The leaves of this plant were exactly six inches wide, as shown by the rule attached to one of the leaves. Note the stout culm and two good-sized ears.

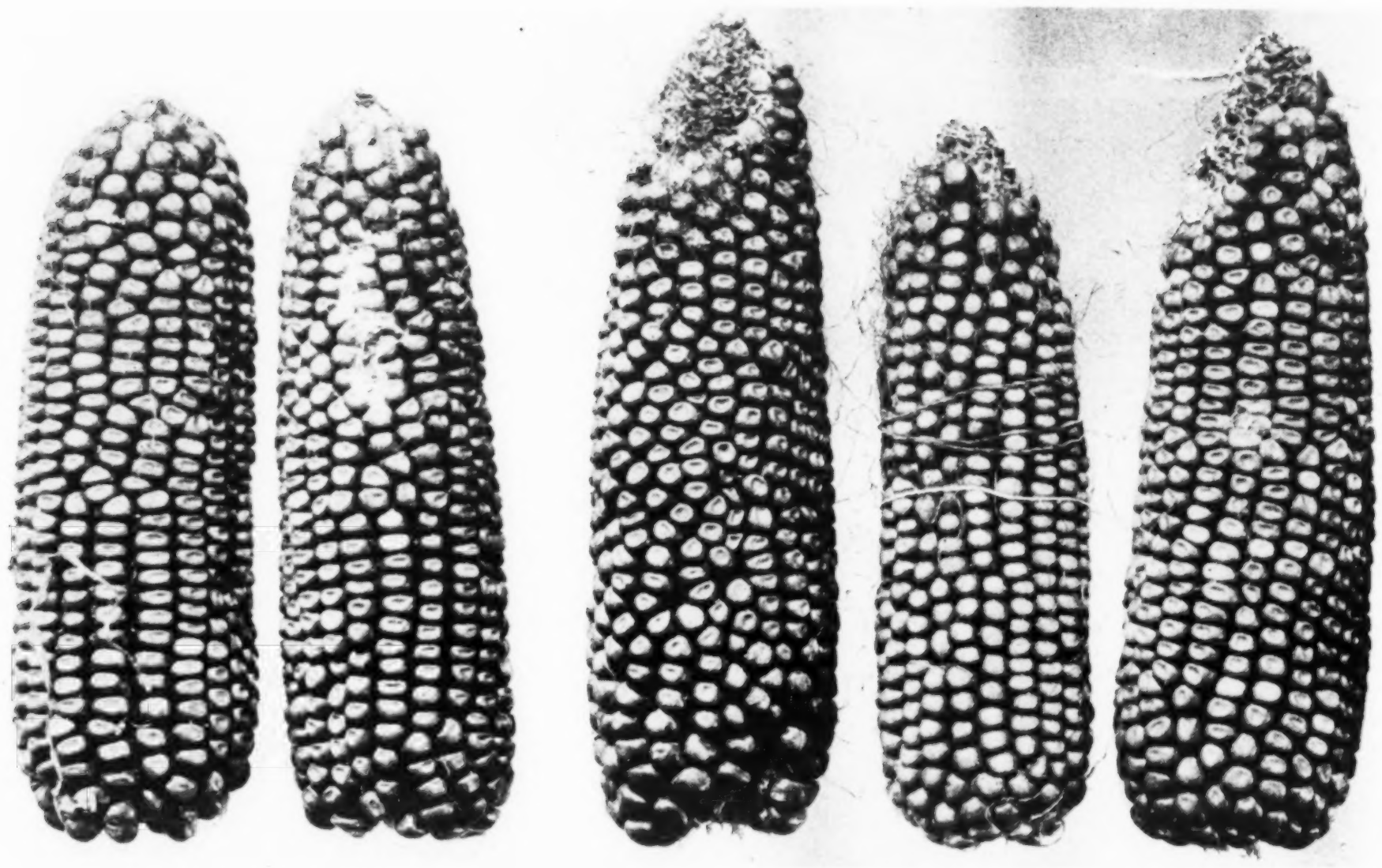
len, the appearance of the silks and the like.

A typical sixth generation gigas plant is shown in Figure 25. The plants were approximately seven feet high and the leaves varied in width from five to a little over seven inches. The leaves of the plant illustrated in Figure 25 were about six inches wide. In Figure 27 is shown a gigas leaf from a sixth generation plant in comparison with a leaf taken from a vigorous plant of Commercial White. In spite of inbreeding, the leaves have retained the extreme width and leathery texture of the original gigas plant. The leaves shown in Figure 27 had been dried before they were photographed, which accounts for the shattering which is apparent.

Another striking characteristic of the inbred gigas strain is the production of two well-developed ears, as may be seen from the plant illustrated in Figure 25. Every single plant in the row produced two good ears. The ears varied from six to eight inches in length and had twenty rows of kernels. The ears shown in Figure 26 were produced on the sixth generation gigas plants grown in Missouri, but the conditions under which the plants were grown did not permit normal development. Unfortunately illustrations of more typical ears are not available at the present time.

The inbred gigas plants produce an abundance of normal pollen. Since practically all the plants begin shedding pollen at the same time, the pollen-shedding period is short as compared with that of cross-bred strains.

In the summer of 1924 about 3,200 sixth generation gigas plants were grown under normal field conditions in eastern Pennsylvania. The plants were grown in a block of eight rows in one corner of a large field of maize, and gave a beautiful picture of uniformity. The plants were approximately eight feet in height and had the general appearance of the plant illustrated in Figure 25.



EARS OF GIGAS MAIZE

Figure 26

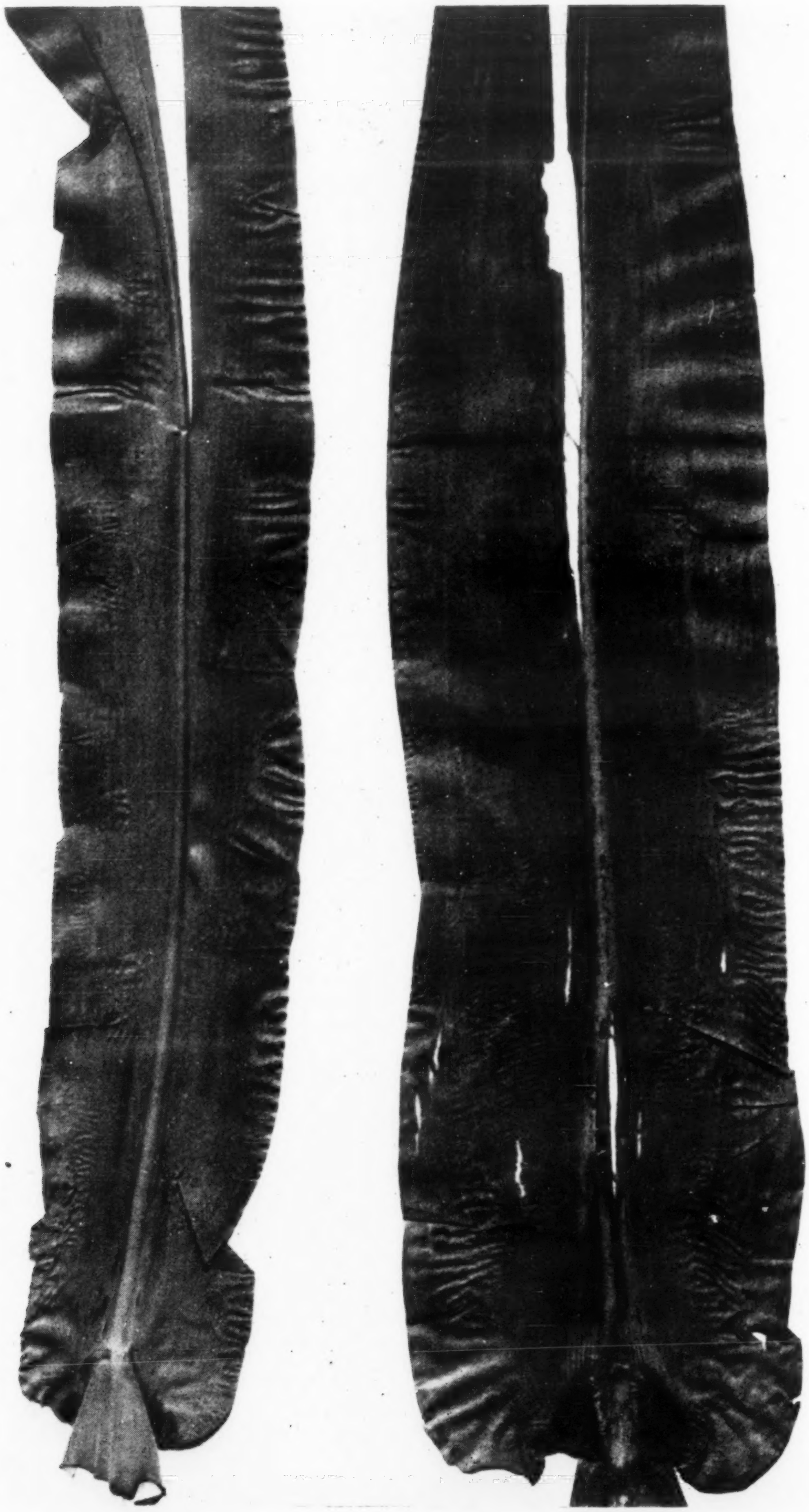
Ears from a number of sixth generation gigas strains taken from plants that were grown on rather poor soil. Ears grown on similar plants on fertile soil in eastern Pennsylvania were considerably larger, but were frozen while immature. The ears average from six to eight inches in length, but practically every plant bears two or three ears.

Measurements were made of 313 plants with special reference to the size of the leaves. In width the leaves varied from around five inches in some plants to a little over seven inches in other plants.

Results of Inter-crossing Gigas and Normal Plants

Crosses have been made between gigas plants and a large number of strains, including many of the leading commercial varieties of maize grown in the Middle West. The hybrids, regardless of which way the cross was made, were remarkably vigorous and possessed the large, leathery leaf of the gigas parent. Typical first generation plants are shown in Figure 28, which happen to be hybrids between a fourth generation gigas plant and an ordinary unpedigreed Commercial White plant. These particular plants were grown from small and poorly matured kernels, due to chinch bug injury of the parent plant. Although the kernels looked as if they might not germinate and the soil in which they were planted was considered unfit for other experiment station work, they grew into plants of unusually large size, most of which had seventeen leaves and two or three ears. In width the leaves varied from a little less than four inches in some plants to seven and one-half inches in other plants. This wide variation in the width of the leaves was doubtless due, in part at least, to the extreme lack of uniformity of the soil.

More than 1,000 F_2 plants from crosses between the gigas and normal strains of maize were grown in eastern Pennsylvania in the summer of 1924. Careful leaf measurements were made of two progenies, involving 445 plants, and it was found that the leaves varied in width from three and one-half inches in some plants to seven and one-half inches in other plants. The results found were not what would be expect-



LEAVES OF NORMAL AND OF GIGAS MAIZE

Figure 27

Leaf taken from a sixth generation gigas plant in comparison with a leaf from a vigorous plant of an unpedigreed strain of Commercial White. The leaves had been dried before they were photographed, which accounts for the shattering which is apparent.

A ROW OF GIGAS PLANTS

Figure 28

A row of first generation hybrids between a fourth generation gigas plant and an unpedigreed plant of Commercial White. The tremendous vigor of these plants is easily apparent. These plants grew to a huge size, having seventeen leaves and from two to three ears on each plant.

ed on the basis of a single factor difference for the gigas character, unless they were obscured by lack of uniformity in the environmntal factors or by the segregation of other growth factors.

Grain Yield of Gigas Plants

Although the inbred gigas plants produce an unexpected vegetative growth, there is a noticeable reduction in the size of the ear. However, each plant almost invariably produces two ears, varying in length from six to eight inches and having twenty rows of kernels. Preliminary comparisons in yield of grain were made involving fifth generation gigas plants, an unpedigreed strain of Commercial White, several hybrid strains between an inbred gigas strain and Commercial White, and a number of hybrid strains between gigas and other commercial varieties. Under the conditions of the test, which included very unfavorable soil conditions, the inbred gigas strain outyielded Commercial White, while each of the hybrid strains produced at least three times as much grain as the Commercial White strain. Doubtless under conditions more favorable to the Commercial White strain the differences would have been less striking. Since this comparison included only a single row of each strain, it is worth little more than evidence of the tremendous vigor not only of the gigas-normal hybrids but of the inbred gigas strain itself.

Drought Resistance of The Gigas Strain

A remarkable as well as a most unexpected characteristic of the gigas strain is its apparent resistance to drought. During the summer of 192? there was a prolonged dry period which began at about the time the plants in the experimental field were coming into tassel. The gigas plants retained their deep green color and showed only slight indications of wilting and rolling of the leaves, while practically all the other plants in the field had their leaves rolled, wilted, and more or less injured from burning. The gigas plants could be distinguished from a considerable distance and had the appearance of a row of plants that had been irrigated. Because of the large leaf surface exposed to the air it was to be expected that the gigas plants would have a high rate of transpiration and would therefore suffer more than normal plants in times of drought. The reason for this apparent xerophytic character has not been determined, but seems to be associated with the thick, leathery texture of the leaves.

Error in Numbering Heritable Characters Series

Through a typographical error, Dr. E. W. Lindstrom's contribution to the "Heritable Characters of Maize" Series in the April Journal was misnumbered. The correct number of *Tcopod* in the series is 21, not 16; and the next character to be described will be No. 22.—*Editor.*